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Electronic Fire Alarm

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Abstract

Fire alarms are used in the event of a fire or fire drill. They are activated either manually or automatically. After the fire protection goals are established–usually by referencing the minimum levels of protection mandated by the appropriate model building code, insurance agencies, and other authorities–the fire alarm designer undertakes to detail specific components, arrangements, and interfaces necessary to accomplish these goals[1]. This paper specifies various circuits for detecting fire.

Keywords: Diodes, fire, alarm, thermistor.

1. Introduction

A fire alarm circuit is very useful for security reasons. Equipment specifically manufactured for these purposes are selected and standardized installation methods are anticipated during the design. Various circuits can be designed for this purpose[2].

2. Requirements for Proper use of Fire Alarm Systems

For residential applications, smoke detectors should be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms and on each additional story of the family living unit, including basements and excluding crawl spaces and unfinished attics. Smoke detectors should be installed in sleeping rooms in new construction and it is recommended that they should also be installed in sleeping rooms in existing construction. It is recommended that more than one smoke detector should be installed in a hallway if it is more than 30 feet long. It is recommended that

there should never be less then two smoke detectors per apartment or residence. It is recommended that smoke detectors be located in any room where an alarm control is located, or in any room where alarm control connections to an AC source or phone lines are made. If detectors are not so located, a fire within the room could prevent the control from reporting a fire. All fire alarm systems require notification devices, including sirens, bells, horns, and/or strobes. In residential applications, each automatic alarm initiating device when activated should cause the operation of an alarm notification device that should be clearly audible in all bedrooms over ambient or background noise levels (at least 15dB above noise) with all intervening doors closed. It is recommended that a smoke detector with an integral sounder (smoke alarm) be located in every bedroom and an additional notification device be located on each level of a residence. The most common cause of an alarm system not functioning when a fire occurs is inadequate maintenance. As such, the alarm system should be tested weekly to make sure all sensors and transmitters are working properly. Although designed for long life, fire alarm devices including smoke detectors may fail at any time. It is recommended that residential smoke detectors should be replaced every 10 years. Any smoke detector, fire alarm system or any component of that system which fails should be repaired or replaced immediately[3].

3. Circuits

3.1 Thermistor based Circuit

A thermistor is a type of resistor whose resistance varies significantly with temperature, more so than in standard resistors. The word is a portmanteau of thermal and resistor. Thermistors are widely used as inrush current limiters, temperature sensors, self-resetting overcurrent protectors, and self-regulating heating elements.Thermistors differ from resistance temperature detectors (RTD) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while thermistors typically achieve a higher precision within a limited temperature range, typically −90 °C to 130 °C.It is a small and simple unit that can be used for Home-Security purpose. In this fire alarm circuit, a Thermistor works as the heat sensor. When temperature increases, its resistance decreases, and vice versa. At normal temperature, the resistance of the Thermistor (TH1) is approximately 10 kilo-ohms, which reduces to a few ohms as the temperature increases beyond 100 C. The circuit uses readily available components and can be easily constructed on any general-purpose PCB. The component values used are as follows:R1=470R, R2=470R, R3=33K, R5=560R R4=470R, R6=47K, R7=2.2K, R8=470R, C1=10uF-16V, C2=0.04uF-63V, C3=0.01uF-63V, Q1=BC548, Q2=BC558, Q3=SL100B, D1=Red Led, D2=1N4001, IC1=NE555, SPKR=1W-8R, TH1=Thermistor-10K

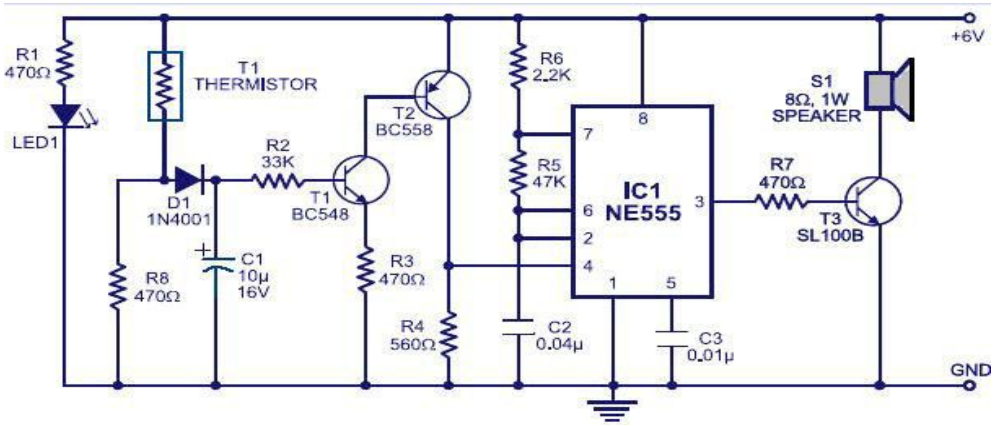

Fig. 1: Thermistor base fire alarm circuit.

Timer IC NE555 (IC1) is wired as an astablemultivibrator oscillating in audio frequency band. Switching transistors Q1 and Q2 drive multivibrator IC1. The output of IC1 is connected to NPN transistor Q3, which drives the loudspeaker (SPKR) to generate sound. The frequency of IC1 depends on the values of resistors R6, R7 and capacitor C2. When Thermistor TH1 becomes hot, it provides a low-resistance path to extend positive voltage to the base of transistor Q1 via diode D2 and resistor R3. Capacitor C1 charges up to the positive voltage and increases the 'on' time of alarm. The higher the value of capacitor C1, the higher the forward voltage applied to the base of transistor Q1. Since the collector of transistor Q1 is connected to the base of transistor Q2, transistor Q2 provides positive voltage to reset pin 4 of IC1. R5 is used such that IC1 remains inactive in the absence of positive voltage. D2 stops discharging of capacitor C1 when the Thermistor connected to the positive supply cools down and provides a high-resistance (10k) path. It also stops the conduction of Q1. To prevent the Thermistor from melting, wrap it up in mica tape. The circuit works off a 6V-12V regulated power supply. D1 is used to indicate that power to the circuit is switched on[4].

4. Low Cost Fire Alarm Circuit

When there is a fire breakout in the room the temperature increases. This ultra compact and low cost fire alarm senses fire breakout based on this fact. Transistor BC177 (Q1) is used as the fire sensor here. When the temperature increases the leakage current of this transistor also increases. The circuit is designed so that when there is an increase in the leakage current of Q1, transistor Q2 will get biased. As a result when there is a fire breakout the transistor Q2 will be on. The emitter of Q2 (BC 108) is connected to the base of Q3(AC 128).

So when Q2 is ON Q3 will be also ON. The transistor Q3 drives the relay which is used to drive the load ie,light,bell,horn etc as an indication of the fire. The diode D1 is used as a free wheeling diode to protect it from back EMF generated when relay is switched. The Preset R1 can be used to desired temperature level for setting the alarm

ON. This is not a latching alarm, that is; when the temperature in the vicinity of the sensor decreases below the set point the alarm stops. The circuit can be powered using a 9V battery or a 9V battery eliminator. All capacitors are electrolytic and must be rated at least 10V. The load can be connected through the C, NC, NO points of the relay according to your need.

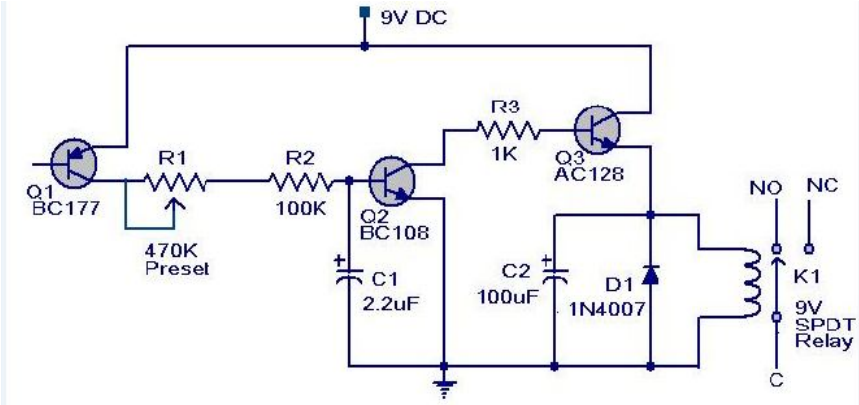

Fig. 2: Low cost Fire Alarm Circuit.

The calibration can be done using a soldering iron, and a thermo meter. The operations are: Switch ON the power supply.Keep the tip of soldering iron near to the Q1. Same time also keep the thermometer close to it. When the temperature reaches your desired value adjust R1 so that relay gets ON.Done![5].

4.1 Low Power Circuit

An alternative circuit can be designed that consumes less power. The circuit comprises of the diodes, transistors alarm and other basic components and provides very useful advantage of low power dissipation.

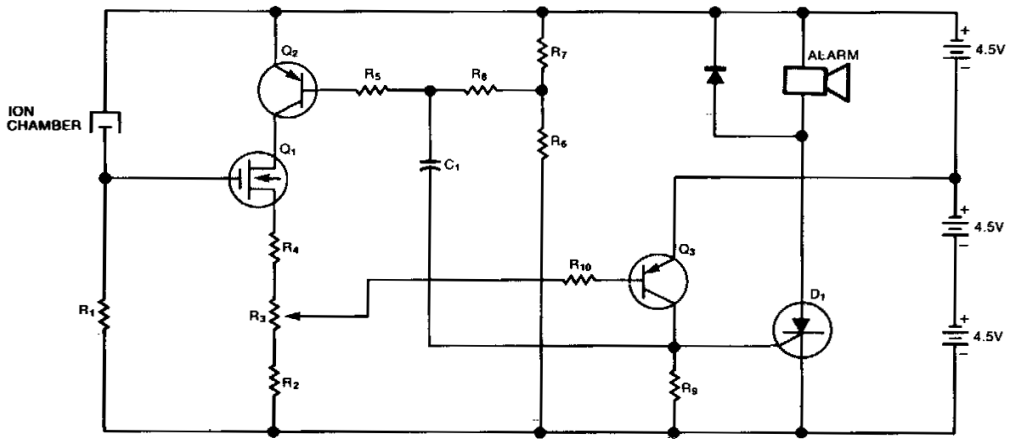

Fig. 3: Fire Alarm Circuit[6]

5. Smoke Detector

A simple smoke sensing alarm circuit can be designed using 555 timer. By using this circuit, one can detect smoke and it alarms when the air is contaminated. The components used are: IC- NE555 Timer, Sensor- Photo Interrupter Module and Speaker. This smoke detecting alarm is based directly on an astablemultivibrator and sensor. The sensing module triggers the oscillator and generates an alarm through the loud speaker.

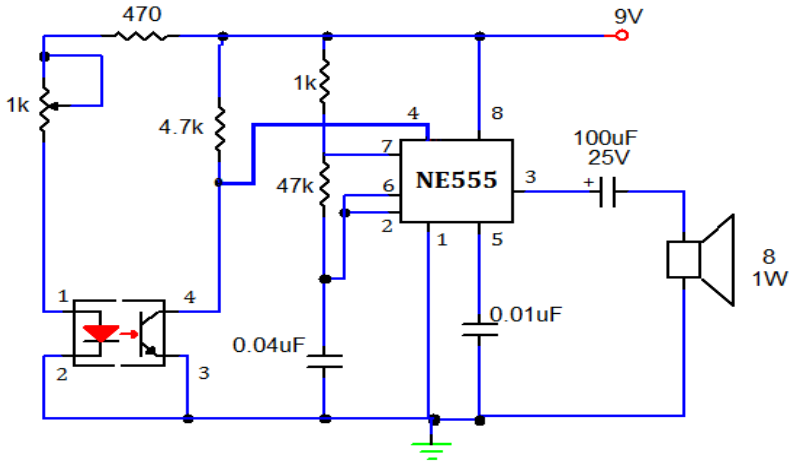

Fig. 4: Smoke Detector.

The photo interrupter module consists of an LED and a Photo transistor. The light coming from the led falls directly onto the photo transistor, this makes the collector terminal to go ground potential and activates the reset control of 555 timer. If there is an interrupt on the path of LED and Photo transistor as smoke, the light doesn't reaches the transistor causing the collector voltage approximately equal to supply voltage and it is fed directly to the reset pin of NE555, which is wired as astablemultivibrator. The high voltage at this pin enables the ic and it produce square waves continuously, which in turn drives the speaker through a coupling capacitor. Here the astablemultivibrator is configured as AF oscillator with a frequency of 379Hz, so as to hear the alarm through loud speaker[7].

6. Conclusion

Hence electronic circuits can be designed for the fire based alarms and they provide very high efficiency and can be used for the security reasons.Early fire detection is best achieved by the installation and maintenance of fire detection equipment in all rooms and areas of the house or building. The various circuits described in the paper can be used.

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